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A NEW MUTATION IN THE HOUSE MOUSE[1]

A new and distinct mutation in mammals is not a frequent occurrence, and therefore the record of a recent dilute form of the house mouse, allelomorphic to color and albinism, is perhaps justifiable.

The infrequency of mutations in mammals may be due to greater stability of the germ plasm than in such forms as insects, for example, *Drosophila;* or may be due to our lack of opportunity for examining as large a population of mammals as of insects; or possibly may be due to a more frequent lethal effect associated with mutations in mammals. Whatever the cause is, a tendency toward similar mutations in closely related groups of mammals is apparent and suggestive. The fact that a given type of mutation has occurred in one group is some promise that a corresponding mutation is possible and may occur in a closely related group. The pink-eyed mutation (giving pink-eyed colored varieties) in mice has been known for some time. A similar mutation in rats was described recently (Castle, '14).[2]

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[1] Paper No. 17, Genetics Laboratory, Illinois Agricultural Experiment Station.

[2] Castle, W. E., 1914, Am. Nat., Vol. 48, p. 65.

In both rats and mice, this gene greatly reduces the production of black and brown hair pigment, but leaves yellow undisturbed. The linkage of pink-eye to albinism in both forms gives added evidence that these genes are similar if not actually identical. A gene for pink-eye is also known in the guinea pig (Castle '14)[3], but it has not yet been established that pink-eye and albinism are linked in this form. It may be unsafe to homologize strictly the gene for pink-eye in mice and rats with the gene in guinea pigs which produces similar somatic effects. A deep red-eyed (almost black-eyed) yellow rat has also been described (Castle, '14).[4] The gene for red-eye is linked to the gene for pink-eye. This mutation has not yet been observed in mice. Brown varieties of mice and guinea pigs have been known for a long time. Brown rabbits (the Havana variety) and the brown roof rat (Patterson, '20)[5] are recent productions. While no brown variety of the common rat (*Mus norvegicus*) is known, the form should be possible and its discovery is only a matter of time and opportunity. A set of quadruple allelomorphs in the guinea pig includes intense color, dilution, ruby-eyed dilution and Himalayan albinism (Wright, '15).[6] Soon after these forms were found, Whiting and King ('18)[7] reported ruby-eyed dilution in rats, an allelomorph of both color and albinism. While Whiting and King used the same symbol, c_r, for this gene that Wright used for ruby-eyed dilution in guinea pigs, they point out that the somatic effect is somewhat different. The two cases of ruby-eyed dilution may not be identical, for it is conceivable that numerous dilution effects in the color-albino series are possible. Ordinary color dilution still remains to be found in rats, in order to make up a series of color allelomorphs as elaborate as in the guinea-pig. Similar examples of apparently parallel or identical mutations in closely related groups can be shown in other animals, as in the color varieties of the horse and the ass, for example, and in the case of the *Drosophila* species.

In an effort to homologize the genes which affect the quality and distribution of hair pigment in the mouse, rat, guinea pig and rabbit, I was impressed by the dearth of color allelomorphs in mice, such as cause the various grades of dilution in the rat and guinea pig. It appeared that similar changes in the mouse were possible and could be found, if persistently sought. With this general thought in mind, I attempted by corresponding with fanciers *et cetera* to locate dilute mutations in mice, thinking that the dark red-eyed yellow mutation (parallel to the type found in rats) or the dilute forms allelomorphic to color and albinism (parallel to the guinea-pig and rat series) might be possibilities. My correspondence with fanciers brought no results, but a dilute mutation appeared from a rather unexpected source. On August 31, 1920, Mr. J. E. Knight of Weldon, Illinois, who exterminates rodents from corn cribs, poultry houses and the like, and who has much opportunity to examine a large number of these mammals, brought to my laboratory a young male mutant mouse which he had captured in a corn crib, located on a farm seven miles from the nearest town. This animal on a first and cursory examination, gave the appearance of being an ordinary black-eyed white in which the hair was apparently very slightly stained or dirty. Realizing that such a form would mean a double (and therefore much more improbable) mutation from the wild, in which both dominant and recessive spotting occurred simultaneously, I made a more careful examination about one month later and found that the hair had become darker. I have since learned that it is characteristic of this form to be practically white on the first pelage, but the dorsal hair eventually acquires a brownish shade,—a little lighter than an ordinary pink-eyed brown with a slight dull yellowish cast. There is no clear evidence of an agouti pattern, the base of the hair being light and the apical portion pigmented. The ventral surface is almost white, at least in the presence of agouti. The eyes at birth are somewhat less heavily pigmented than the wild. This difference persists for some time, but when the mutant is full grown I am not sure I can distinguish the eye from the wild type. Dark pigment is quite pronounced in the skin of the ears and scrotum, in which respect this mouse differs from the ruby. eyed rat. The dark eyes and yellowish tinge in the hair at first suggested that the mutation was similar to the dark red-eyed yellow rat. Recent matings have, however, demonstrated quite clearly that it is a third allelomorph in the color-albino series, and may therefore be homologous to the ruby-eyed dilute rat which is allelomorphic to color and albinism.

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[3] *Loc. cit.*

[4] *Loc. cit.*

[5] Patterson, J. T., 1920, *Science*, N. S., Vol. 52, p. 249.

[6] Wright, S., 1915, AM. NAT., Vol. 49, p. 140.

[7] Whiting, P. W., and King, H. D., 1918, *Jour. Exp. Zool.*, Vol. 26, p. 55.

While the hair of the mutant mouse is lighter and the eyes are apparently darker than the ruby-eyed dilute rat, the genetic behavior agrees quite closely in both forms. Nevertheless it is hardly safe to insist that these two mutations are identical, for there may be numerous possible grades or conditions of the color gene. We are also unable to prove that they are different, for the genes may be identical, but simply give different somatic effects since the residual inheritance in the two forms can not be the same. If a new dilute type of mouse can be found which is more like the rat in both genetic behavior and somatic appearance, then we shall be able to state with more assurance that the present mutation is not identical with the dilute rat. Until that event occurs, we can only regard these dilute color mutations in the rat and mouse as samples of a series of possible mutations in the color gene (cf. the red, white, eosin, cherry, et cetera series of multiple allelomorphs in *Drosophila melanogaster*). A similar interpretation applies in any attempt to homologize the members of the guinea-pig series with those of the rat or the mouse series.

Three types of crosses between the mutant male mouse and other color varieties have been made as follows:

1. Mated to homozygous blacks, all of the F_1 offspring were wild gray. In the F_2 the mutant and other expected forms segregated out.

2. Mated to pink-eyed spotted brown, all of the F_1 offspring were wild gray. In the F_2 the expected forms occurred including the mutant type. We have not yet had opportunity to identify the mutant form when homozygous for pink-eye.

3. Mated to albinos, all the F_1 offspring were of the *mutant* type, that is, they are white at birth with eyes rather less heavily pigmented than the wild type. As they grow older, the hair soon approaches the mutant color type, but I can not yet state whether the mutant hair color is incompletely dominant, as in the case of the ruby-eyed dilute rat and guinea pig.

From present indications, this new dilute mutation is certainly recessive to color, and I am inclined to believe it will prove to be incompletely dominant to albinism. The three genes (color, color dilution, and albinism) probably form a series of triple allelomorphs. I shall designate these genes by the symbols C, c^d, and c, respectively. The mutant mouse is homozygous in agouti, black, dark-eye and self pattern, and therefore represents a single factor difference from the ordinary wild type, from which it arose. The new gene should prove to be linked with dark-eye, like its allelomorph, albinism. Since it occupies, in a scale of dominance, an intermediate position between color and albinism, the mutant should give a coupling series when mated to albinos carrying pink-eye $\left(\mathrm{F}^{1} = \frac{c^{d} \qquad P}{c \qquad p}\right)$ but a repulsion series when the same mutant is mated to pink-eyed colored individuals $\left(\mathrm{F}_{1} = \frac{c^{d} \qquad P}{C \qquad p}\right)$.

J. A. Detlefsen.

GENITAL ORGANS OF HERMAPHRODITIC FUR SEALS

The resumption of commercial killing of the surplus and useless males of the fur-seal herd resorting to the Pribilof Islands of Alaska furnished an opportunity to study the life history and anatomy of this group of mammals. After a lapse of six years, killing was begun again in 1918 by the Bureau of Fisheries. Upwards of 33,000 males, mostly young, were secured and their skins preserved for sale by the government. Two hermaphroditic animals were killed among this large number and the writer had an opportunity of examining the sexual organs of both. Such abnormalities of the species have not previously been recorded and since they are rarely found among mammals of any species it seems desirable to note the occurrence with a brief description. The organs of both animals have been deposited in the United States National Museum.

Normally the female Alaska fur-seal has two kidney-shaped ovaries located just forward of the pelvis and loosely invested in the folds of connecting ligaments. Blood vessels, ureters, fallopian tubes and uteri are attached to the same folds. The ureters pass above the genitalia but bend down below to reach the tip of the bladder. The uterus is bicarinate, an ovary being attached to the distal end of each horn. It is pretty well determined that each side functions alternately every other year. The horns unite in the median line and the vagina continues to the exterior, a distance of about 20 cm. Attached to the lower side of the vagina is the pear-shaped and very muscular bladder. The urethra leading therefrom is deeply embedded in the muscular walls of the lower vagina as it passes to its point of discharge near the exterior.